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ABSTRACT

This digest focuses on the impact of the educational reform movement on science education. Topics reviewed are: (1) "What is the message of educational reform?"; (2) "What changes have occurred?" listing increasing graduation requirements and lengthening schooling; (3) "Have educational reform efforts improved education?" reporting the recoveries of achievement scores and the lack of change in teaching methods; and (4) "What are some recommended actions?" suggesting focusing attention on middle school and low-achieving students, and designing an indicator system to track the reform. Fourteen references are listed. (YP)

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THE IMPACT OF EDUCATIONAL REFORM ON SCIENCE EDUCATION

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Prepared by

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U.S. DEPARTMENT OF EDUCATION
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THE IMPACT OF EDUCATIONAL REFORM ON SCIENCE EDUCATION

American public education has always been subject to scrutiny and criticism. This seems to have been particularly evident in the early 1980's when many groups expressed concern about the quality of American education and provided suggestions for reform. This digest is focused on the impact of the educational reform movement on science education in American schools.

What is the message of educational reform?

Educational reformers are concerned about comparisons of American students and those of other nations, and about the apparent inability of American youth to successfully compete in the global marketplace. Their message may be characterized by *A Nation at Risk* (Gardner, 1983). The authors of *A Nation at Risk* deplored the "cafeteria-style curriculum" of American education and urged that it become more uniform, that students be advised to elect either college preparatory or vocational programs rather than "general track" courses, that high school graduation requirements be strengthened, that college admission requirements be raised, that time be used more efficiently for academic learning with the possibility that either the school day or school year be lengthened, and that the attention be given to the improvement of teacher preparation (Gardner, 1983, pp. 18-31).

What changes have occurred?

Again, numerous reports have been published in which efforts to improve education are described. *The Nation Responds* (U.S. Department of Education, May, 1984) indicated that reform efforts were already underway when A Nation at Risk was being prepared for publication. In 1984, 275 State-level task forces had been working on education. Textbooks, career ladders, performance-based pay, and graduation requirements were under review (*The Nation Responds*, 1984, p. 15). When the 50 states and the District of Columbia were considered, 48 of the 51 jurisdictions were considering new high school graduation requirements, with 35 having approved changes. Initiatives to improve textbooks and instructional materials were reported by 21. Eight jurisdictions had approved lengthening the school day; 7, the school year; and 18 had mandates affecting the amount of time for instruction. Master teacher or career ladder programs were being examined in 24, and 6 had begun statewide or pilot programs. Changes in academic requirements for extracurricular and athletic programs were being considered in 13 jurisdictions, and 5 had already adopted more rigorous standards (*The Nation Responds*, 1984, p. 16).

The amount of activity has increased with the passage of time. Reports by Weiss (1987), Blank (1987), and the Education Commission of The States (1987) detail reforms initiated through 1987. Clune et al., reporting on a survey of the 50 states, found that 45 of the 50 states had increased high school graduation requirements, with 42 states adding required courses in mathematics, science, or both. Twenty-one states reported longer school days, 14 states indicated instituting new or modified high school exit examinations. (Clune et al., 1989, p. 1).

Have educational reform efforts improved education?

Reform is designed to bring about change. Change is a process that, in education, does not occur quickly and that is subject to the influence of many variables. Also, to know if change has occurred, it is necessary to have some indicators to provide valid and reliable data. Several authors have provided information on indicators of science and mathematics education (Blank, 1988; Raizen & Jones, 1985; Shavelson, McDonald & Oakes, 1989). Indicators are individual or composite statistics reflecting important features of an educational system or relating to a basic construct in education. They are useful in a policy context. However, indicators cannot set goals and priorities, evaluate programs, or develop a balance sheet. (Shavelson et al., p. 5, 7-8).

The American public appears to accept, an indicator of the quality of science education, the achievement scores of students. If this is a valid measure, then a great deal of positive change cannot be reported. *The Science Report Card* (Mullis & Jenkins, 1988) contains a report on trends and achievement in science. Data from the 1986 science assessment, conducted by the National Assessment of Educational Progress (NAEP), were compared with those collected in previous science rounds. When the data are compared, a pattern of initial declines followed by subsequent recovery was found for all three age groups (9, 13, and 17 year olds). However, the recoveries did not match the declines.

When students were asked for their views of the kinds of science instruction they experienced, the most frequently cited activity was reading the textbook. When asked about the number of experiments conducted in the previous month, 40% of the 9 year-olds, 44% of the 13 year-olds, and 49% of the 17 year-olds answered "0". Despite the push for hands-on activities, lecture and textbook use predominate. Experimentation and use of scientific equipment are relatively rare. However, some of the choices for instruction may be dictated by circumstances - less than half of the teachers surveyed had access to even a general purpose laboratory (Mullis and Jenkins, 1988, p. 101).

Clune et al. (1989) consider the two primary objectives of the reforms to be (1) the improvement of achievement scores and work skills and (2) more uniformity in types of courses in the direction of standard, high-quality academic courses (p. 33). Data from their survey reveal that the implementation of graduation requirements has been prompt and

complete. However, what appears to be large increases in legal requirements at the state level resulted in relatively small increases in practice, due to pre-existing district and university requirements. Such requirements did change the course-taking of students taking the fewest academic courses, so that the minimum - rather than the ceiling - was raised (p. 34). Systematic data about the impact on students taking more science is not available at this time, though some reports suggest student achievement has increased (Mullis and Jenkins, 1988).

Clune et al. do not think that the reforms will result in gains in work skills. Reforms may raise achievement scores in academic subjects but probably not to a large extent. However, if the new graduation requirements eventually produce small gains in a great many students, this could be a substantial contribution to society (1989, p. 37).

Clune and his colleagues do not think that the reforms will increase drop-out rates or adversely affect at-risk students (1989, p. 37). However, they point out two general deficiencies in graduation requirement reforms: Policy design and implementation. In terms of policy design, means and ends have not been clearly related. Research has not been done on what sorts of mathematics and science courses are most useful for which purposes. Research also needs to be done to determine the role of vocational education in reform. Another area that needs to be researched is that of instruction for different kinds of students. What should be the ends of schooling? What should be the central core skills all students should possess? Also, no assistance on the implementation of graduation requirements has been provided (1989, p. 39).

What are some recommended actions?

Based on the analysis of their survey data, Clune et al. recommended that the curriculum should be aimed at higher-order learning objectives. Special attention needs to be paid to instruction for middle and low-achieving students. Related to this, there is need to change the attitudes of school personnel toward these students, eliminating the customary low expectations for such pupils. Different policy instruments need to be used for different purposes and groups of students rather than a few all-encompassing instruments. Technical assistance needs to be designed and provided to schools for improved content. The curriculum should be suited to the local situation. Also, such assistance needs to be provided for teacher training.

An indicator system to track content and course-related achievement needs to be designed and implemented. It should also be sensitive to outcomes after high school. More basic research on curriculum development is needed. Evaluation changes in the policy-making process are needed in terms of stable political influence and sophisticated technical capacity (Clune et al., 1989 pp. 40-45).

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